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# PATENT ABSTRACTS OF JAPAN

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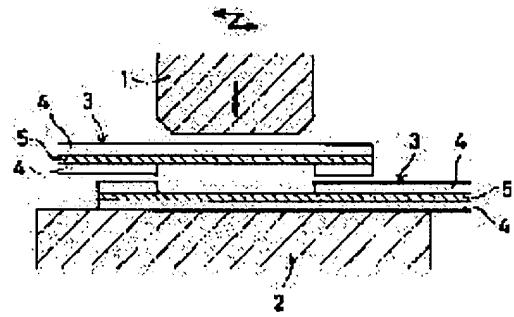
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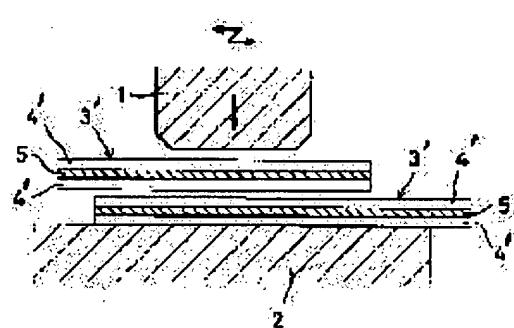
## (54) METHOD OF BONDING CIRCUIT BOARDS

### (57) Abstract:

PURPOSE: To obtain a welding effect whose exfoliation strength is sufficient by a method wherein a part to be bonded is brought into contact with a circuit board part from which an insulating material has been removed and both are bonded by giving ultrasonic vibrations in a state that a static pressure is applied.



CONSTITUTION: Two printed-circuit boards 3 are welded ultrasonically, and conductors (copper foils) 5 on the printed-circuit boards 3 are insulated and protected by insulating materials 4 as polyimide films. In the insulating materials 4, faces, on one side, of the circuit boards 3 are removed in advance in parts in which welded parts are faced in such a way that the insulating materials 4 do not adhere to the parts when the circuit boards 3 are formed in advance. A static pressure is applied to the direction of an anvil 2 by using an ultrasonic vibrator 1, and the vibrator 1 is vibrated in parallel with bonding faces, and the conductor 5 and the conductor 5 are melted by the action of frictional heat so as to be metal-bonded. Since the insulating materials on the faces, on one side, of the circuit boards are removed in advance, objects to be bonded are brought into contact with the removed parts, both are pressurized and bonded by applying the ultrasonic vibrations, the conductors come into direct contact with the parts to be bonded, and it is possible to prevent a welding operation from becoming imperfect when the insulating materials constitute an obstacle.



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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Industrial Application] This invention relates to the junction approach of the circuit board which joins other metal components to the circuit board, or joins other circuit boards.

#### [0002]

[Description of the Prior Art] It is common to connect with the conductor on a printed circuit board using a connector as an approach of connecting metal components and the conductor of other printed circuit boards, or to use and carry out fused junction of the soldering of soldering etc. to both connection conventionally. Although there is an advantage that the connector mentioned above can be detached and attached, since components mark increase, it is expensive, and since there are many crotch article mark, the rate of occupying a tooth space is large, and it is not desirable from a viewpoint of miniaturizing an electronic circuitry.

[0003] therefore, a conductor -- although many soldering is generally used for carrying out direct continuation of the comrades and research and development in the connection method by the bump is done, it may not be desirable in respect of dependability

[0004] then, direct [ by welding of resistance welding, laser welding, ultrasonic welding, etc. ] as an approach of replacing with these -- a conductor -- the attempt which is going to weld comrades is made.

[0005] Ultrasonic welding is the general most reliable approach as an approach of joining metals among the above-mentioned welding processes. As everyone knows, the principle of this ultrasonic welding piles up a weld metal-ed ingredient, places it on a base (Annville), where static pressure is impressed to the plane of composition of metallic materials with the vibrator called a welding tip, it adds vibration with vibrator, and it joins by producing the relative velocity of vibration between welding sides by supersonic vibration parallel to the plane of composition of a metallic material.

[0006] The principle of this ultrasonic welding is applied and the ultrasonic welding approach which connects the copper wire gold-plated by the printed wiring substrate with which the terminal area was gold-plated is indicated by JP,55-41871,B. Contact arrangement of the gold plate copper wire is carried out at the above-mentioned substrate plating terminal area, and he is trying to apply a pressure to both, and to add supersonic vibration by this approach, until metallic bond is formed between gold plate.

[0007] as other applications -- the conductor of a printed-circuit board -- the approach of making stick a terminal to a circuit and connecting is indicated by JP,4-212277,A.

#### [0008]

[Problem(s) to be Solved by the Invention] However, according to the ultrasonic welding method by the first official report of the above, both the terminal areas and copper wire of a wiring substrate need to plate, and, for this reason, have the problem that cost becomes high.

[0009] Moreover, according to the ultrasonic welding by the second official report, the adhesives on which a resin ingredient, and the substrate and copper foil of a substrate are pasted up may deteriorate with heat.

[0010] moreover, the above -- when applying a general ultrasonic welding method to a printed circuit

board, since the insulator unremovable in supersonic vibration is generally contained in the printed circuit board, supersonic vibration does not get across to the weld zone of a conductor directly, therefore there is a difficulty that bonding strength lacks in dispersion and dependability greatly.

[0011] With careful attention to the trouble of the junction approach of the circuit board by the above-mentioned conventional ultrasonic welding, in case this invention welds solder-ed to the conductor of the circuit board, beforehand, it prepares so that it may suit as an ingredient geometrically, carries out perfect ultrasonic welding so that an insulating material may not serve as a failure of ultrasonic welding, and makes it a technical problem to offer the junction approach of the circuit board that sufficient welding effectiveness of peel strength can be acquired.

[0012]

[Means for Solving the Problem] As a means to solve the above-mentioned technical problem, by this invention, solder-ed was made to contact the circuit board part by which the insulating material was removed at least, removing beforehand the insulating material which carries out insulation protection of the conductor of the circuit board single-sided side picking, and it considered as the junction approach of the circuit board which consists of giving supersonic vibration and joining where static pressure is applied.

[0013] By this approach, said solder-ed can be used as the circuit board, and that insulating material can be removed single-sided side picking at least beforehand.

[0014] Moreover, the insulating material of a weld can be beforehand formed by pre-insulation removable at the time of ultrasonic welding at least as another means which can solve the above-mentioned technical problem among the insulating materials which carry out insulation protection of the conductor of the circuit board, solder-ed can be made to be able to contact a weld, and the junction approach of the circuit board which consists of giving supersonic vibration where static pressure is applied, removing pre-insulation, and joining to a conductor can also be adopted.

[0015]

[Function] By the junction approach by the first above-mentioned invention, the insulating material of the part which is going to join the circuit board is removed beforehand, and solder-ed is directly contacted by this removal part. therefore -- if supersonic vibration is added with an ultrasonic vibrator -- a mechanical friction -- a conductor -- a part fuses and perfect welding with solder-ed is performed.

[0016] By the junction approach of the second invention, when solder-ed is the circuit board, the insulating material of the circuit board of the solder-ed is also removed beforehand. therefore, a conductor -- comrades contact directly and perfect ultrasonic welding is obtained.

[0017] By the approach of the third invention, the thing beforehand removable by ultrasonic welding as an insulating material of a weld is chosen and used. therefore, even if it is the circuit boards in which the insulating material is formed, at the time of ultrasonic welding, an insulating material removes first -- having -- after that -- a conductor -- ultrasonic welding of the comrades is carried out. Therefore, perfect welding is performed even if it is an insulating material.

[0018]

[Example] The example of this invention is explained with reference to a drawing below. The sectional view of the approach of carrying out ultrasonic welding of the circuit board which used the polyimide film as the insulating material to drawing 1 is shown. 1 is an ultrasonic vibrator and 2 is Annville (base).

[0019] In this example, the example which carries out ultrasonic welding of the printed-circuit-board 3 same flexible comrades of two sheets is shown, and the printed circuit board 3 is carrying out insulation protection of the conductor (copper foil) 5 with the insulating material 4 of the polyimide film. An insulating material 4 is made to 25 micrometers, and the conductor 5 is made into the thickness of 18 micrometers in this example.

[0020] Moreover, the insulating material 4 is beforehand removed in one side of the circuit board 3 like illustration in the part of a weld which faces mutually. this insulating material -- removing -- in case the circuit board 3 is formed beforehand, it is made for an insulating material 4 not to adhere to that part

[0021] And static pressure is applied in the direction of Annville 2 with an ultrasonic vibrator 1 in the

state of illustration, when vibrator 1 vibrates to a plane of composition and parallel, in a frictional heat operation, a conductor 5 and a conductor 5 fuse and metal junction is carried out.

[0022] Drawing 2 is the sectional view showing the example which removed the insulating material 4 beforehand by both sides of the circuit board 3. It is completely the same as the case of drawing 1 except the point that the double-sided insulating material 4 is removed.

[0023] Drawing 3 is the sectional view of the example which carries out ultrasonic welding of the printed circuit board of other examples. Although insulating material 4' of the polyvinyl chloride film is used for printed-circuit-board 3' and it is the same as the example of drawing 1 and drawing 2 about thickness, it is the comparatively low resin ingredient of the melting point as an ingredient, and the synergism of the mechanical work of frictional heat and sliding by sliding at the time of ultrasonic welding is easy to remove it from a plane of composition.

[0024] Therefore, in this example, it has not carried out removing an insulating material beforehand by the weld unlike the example of drawing 1 and drawing 2. Moreover, insulating material 4' is good also considering whole printed-circuit-board 3' as a thing of the same quality of the material, or makes only a part for a joint the thing of the above-mentioned quality of the material, and others may be made to be taken as the polyimide film.

[0025] Furthermore, although the cross section is the same as the thing of drawing 3 as other examples, printed-circuit-board 3' may be constituted, using the polyethylene film as insulating material 4'. Also in this case, insulating material 4' is a resin ingredient with the comparatively low melting point, and the synergism of the mechanical work of frictional heat and sliding by sliding at the time of ultrasonic welding is easy to remove it from a plane of composition.

[0026] the supersonic vibration to which the part which contacts mutually first by supersonic vibration in the plane of composition of insulating material 4' is removed, and it is further added after that in the two examples shown in above-mentioned drawing 3 in any case -- a conductor -- comrades will be joined.

[0027] The standard deviation value which shows dispersion in the peel strength and reinforcement of the joint by the experiment at the time of carrying out ultrasonic welding of the printed circuit boards about two examples shown in drawing 3 among the above examples is shown in Table 1. In addition, the data about a printed circuit board using conventional polyimide as an insulating layer are displayed on reference as comparison material. Moreover, the case of PVC and the polyethylene film is displayed for the case of the polyvinyl chloride film as PE as an insulating material of drawing 3.

[0028] By this experiment, the data of a display are the frequency of 20kHz, the amplitude of 30 micrometers, and the static compression force 3 kgf(s)/mm about vibration added to the vibrator for ultrasonic welding 2 All are obtained as the same conditions on conditions.

[0029]

[Table 1]

表 1

実施例	剥離強度 (kgf/cm)	標準偏差
PVC	18.5	2.1
PE	14.7	1.9
比較例	0.5	5.5

[0030]

[Effect] As explained to the detail above, by the junction approach of the circuit board by invention of the first of this application, it is prevented that welding of the circuit board with which the conductor was directly contacted by solder-ed and the insulating material interfered since remove the insulating material of a single-sided side beforehand at least, and make solder-ed contact this removed part, it

pressurizes, supersonic vibration is added and it was made to join becomes imperfect.

[0031] if remove the insulating material of the single-sided side beforehand at least, the parts are made to contact and ultrasonic welding is carried out by the approach of the second invention, when the other party's solder-ed is the circuit board -- the same -- a conductor -- the advantage that ultrasonic welding of the comrades is carried out completely is acquired.

[0032] since make the insulating material of the circuit board into what can be removed about a weld beforehand at least at the time of ultrasonic welding, and make solder-ed contact this, it pressurizes, supersonic vibration is added and it was made to join according to the approach of the third invention -- a conductor -- even if it carries out ultrasonic welding, with the pre-insulation of the part carried out, a perfect welding result is obtained, and good welding without dispersion in peel strength is attained.

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[Translation done.]

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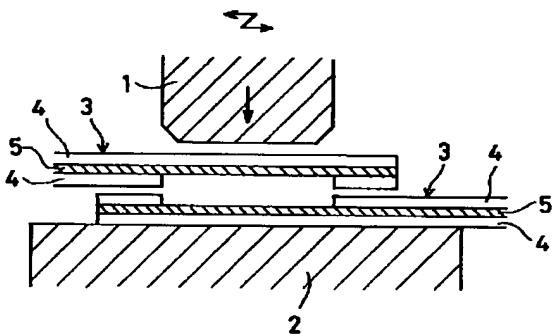
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(54)【発明の名称】 回路基板の接合方法

(57)【要約】

【目的】 回路基板の絶縁材が超音波溶接時に障害とならないようにして完全な溶接を実現する。

【構成】 超音波振動子1とアンビル2との間に回路基板3と3を重ねて超音波溶接する。回路基板3、3は溶接部分の絶縁材が予め取り除かれており、その除去された部分の導体同士を互いに当接させ加圧して超音波振動により溶接する。



## 【特許請求の範囲】

【請求項1】回路基板の導体を絶縁保護する絶縁材を予め少なくとも片側面取り除き、絶縁材の取り除かれた回路基板部分に被接合物を当接させ、静圧力を加えた状態で超音波振動を付与して接合することから成る回路基板の接合方法。

【請求項2】前記被接合物を回路基板とし、その絶縁材を予め少なくとも片側面取り除いておくことを特徴とする請求項1に記載の回路基板の接合方法。

【請求項3】回路基板の導体を絶縁保護する絶縁材のうち予め少なくとも溶接部分の絶縁材を超音波溶接時に除去可能な絶縁被覆により形成し、溶接部分に被接合物を当接させ、静圧力を加えた状態で超音波振動を付与して絶縁被覆を除去し導体に接合することから成る回路基板の接合方法。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】この発明は、回路基板に他の金属部品を接合したり、あるいは他の回路基板を接合したりする回路基板の接合方法に関する。

## 【0002】

【従来の技術】従来、プリント回路基板上の導体に金属部品や他のプリント回路基板の導体を接続する方法として、コネクタを使用して接続するか、又は両者の接続部に半田付け等のろう付けを用いて溶融接合するのが一般的である。上述したコネクタは着脱できるという利点はあるが、部品点数が増加するために高価であり、又部品点数が多いためにスペースを占有する割合が大きく、電子回路を小型化するという観点からは好ましくない。

【0003】従って、導体同士を直接接続するのには一般に半田付けが多く用いられ、バンプによる接続方法が研究開発されているが、信頼性の点で好ましくない場合がある。

【0004】そこで、これらに代わる方法として、例えば抵抗溶接、レーザー溶接、超音波溶接等の溶接により直接導体同士を溶接しようとする試みがなされている。

【0005】上記溶接方法のうち、超音波溶接は金属同士を接合する方法として一般には最も信頼性の高い方法である。この超音波溶接の原理は、周知のように、被溶接金属材料を重ね合せて台(アンビル)上に置き、溶接チップと呼ばれる振動子で金属材料同士の接合面に静圧力を印加した状態で振動子により振動を加え、金属材料の接合面に平行な超音波振動により溶接面間に相対振動速度を生じさせて接合を行なうものである。

【0006】かかる超音波溶接の原理を応用して、端子部が金メッキされた印刷配線基板に金メッキされた銅線を接続する超音波溶接方法が特公昭55-41871号公報に開示されている。この方法では、上記基板メッキ端子部に金メッキ銅線を接触配置し、両者に圧力を加え金メッキ相互間に金属結合が形成されるまで超音波振動

を加えるようにしている。

【0007】他の応用例として、プリント配線基板の導体回路に端子を密着させて接続する方法が特開平4-212277号公報に開示されている。

## 【0008】

【発明が解決しようとする課題】しかし、上記第一の公報による超音波溶接法によると、配線基板の端子部や銅線は共にメッキを施すことを必要とし、このため、コストが高くなるという問題がある。

10 【0009】又、第二の公報による超音波溶接によると、基板の樹脂材料、基板と銅箔を接着している接着剤が熱により劣化する可能性がある。

【0010】又、上記一般的な超音波溶接法をプリント回路基板に適用する場合、一般にはプリント回路基板には超音波振動では除去できない絶縁体が含まれているため超音波振動が導体の溶接部に直接伝わらず、そのため接合強度が大きくばらつき、信頼性に欠けるという難点がある。

20 【0011】この発明は、上記従来の超音波溶接による回路基板の接合方法の問題点に留意して、回路基板の導体に被接合物を溶接する際に絶縁材が超音波溶接の障害とならないように予め形状的に、あるいは材料として適合し得るように準備をして完全な超音波溶接をし、剥離強度の十分な溶接効果を得ることのできる回路基板の接合方法を提供することを課題とする。

## 【0012】

【課題を解決するための手段】上記課題を解決する手段としてこの発明では、回路基板の導体を絶縁保護する絶縁材を予め少なくとも片側面取り除き、絶縁材の取り除かれた回路基板部分に被接合物を当接させ、静圧力を加えた状態で超音波振動を付与して接合することから成る回路基板の接合方法としたのである。

【0013】この方法では、前記被接合物を回路基板とし、その絶縁材を予め少なくとも片側面取り除いておくことができる。

30 【0014】又、上記課題を解決し得る別の手段として、回路基板の導体を絶縁保護する絶縁材のうち予め少なくとも溶接部分の絶縁材を超音波溶接時に除去可能な絶縁被覆により形成し、溶接部分に被接合物を当接させ、静圧力を加えた状態で超音波振動を付与して絶縁被覆を除去し導体に接合することから成る回路基板の接合方法を採用することもできる。

## 【0015】

【作用】上記第一の発明による接合方法では、回路基板の接合しようとする部分の絶縁材は予め除去されており、この除去部分に被接合物が直接当接される。従って、超音波振動子により超音波振動を加えると機械的摩擦により導体部分が溶融して被接合物との完全な溶接が行なわれる。

50 【0016】第二の発明の接合方法では、被接合物が回

路基板である場合、その被接合物の回路基板の絶縁材も予め取り除かれている。従って、導体同士が直接当接して完全な超音波溶接が得られる。

【0017】第三の発明の方法では、溶接部分の絶縁材として予め超音波溶接で除去可能なものを選択して用いている。従って、絶縁材が設けられている回路基板同士であっても超音波溶接時にはまず絶縁材が除去され、その後導体同士が超音波溶接される。従って、絶縁材であっても完全な溶接が行なわれる。

#### 【0018】

【実施例】以下この発明の実施例について図面を参考して説明する。図1にポリイミド膜を絶縁材とした回路基板を超音波溶接する方法の断面図を示す。1は超音波振動子、2はアンビル(台)である。

【0019】この実施例では、同じフレキシブルな2枚のプリント回路基板3同士を超音波溶接する例を示しており、プリント回路基板3はポリイミド膜の絶縁材4で導体(銅箔)5を絶縁保護している。絶縁材4は、この実施例では25μm、導体5は18μmの厚さとしている。

【0020】又、絶縁材4は、図示のように、溶接部分の互いに向い合う部分で回路基板3の片側を予め取り除かれている。この絶縁材の取除きは、予め回路基板3を形成する際にその部分に絶縁材4が付着しないようにする。

【0021】そして、図示の状態で超音波振動子1でアンビル2の方向へ静圧力を加え、振動子1が接合面と平行に振動することにより導体5と導体5が摩擦熱作用で溶融して金属接合される。

【0022】図2は絶縁材4を回路基板3の両面で予め取り除いた例を示す断面図である。両面の絶縁材4が取り除かれている点以外は図1の場合と全く同じである。

【0023】図3は他の実施例のプリント回路基板を超音波溶接する例の断面図である。プリント回路基板3'は、ポリ塩化ビニル膜の絶縁材4'を用いており、厚さについては図1、図2の例と同じであるが、材料としては融点の比較的低い樹脂材料であって、超音波溶接時の摺動による摩擦熱と摺動の機械的作用の相乗作用により接合面から除去し易いものである。

【0024】従って、この例では図1、図2の例と異なり絶縁材を溶接部分で予め取除くことはしていない。

又、絶縁材4'は、プリント回路基板3'の全体を同一材質のものとしてもよいし、あるいは接合部分のみを上記材質のものとし、その他はポリイミド膜とするようにしてもよい。

【0025】さらに、他の実施例として断面は図3のものと同じであるが、絶縁材4'としてポリエチレン膜を用いてプリント回路基板3'を構成してもよい。この場合も絶縁材4'は、融点が比較的低い樹脂材料であり、超音波溶接時の摺動による摩擦熱と摺動の機械的作用の相乗作用により接合面から除去し易いものである。

相乗作用により接合面から除去し易いものである。

【0026】上記図3に示す2つの実施例では、いずれの場合も超音波振動によりまず絶縁材4'の接合面で互いに当接する部分が除去され、その後さらに加えられる超音波振動により導体同士が接合されることになる。

【0027】以上の実施例のうち、図3に示す2つの実施例についてプリント回路基板同士を超音波溶接した場合の実験による接合部の剥離強度とその強度のばらつきを示す標準偏差値を表1に示す。なお、比較材として従来のポリイミドを絶縁層として用いたプリント回路基板についてのデータを参考に表示する。又、図3の絶縁材としてポリ塩化ビニル膜の場合をPVC、ポリエチレン膜の場合をPEと表示する。

【0028】この実験では、表示のデータは超音波溶接用の振動子に加える振動を周波数20KHz、振幅30μm、静加圧力を3kgf/mm<sup>2</sup>の条件で全て同一条件として得たものである。

#### 【0029】

【表1】

表 1

実施例	剥離強度 (kgf/cm)	標準偏差
PVC	18.5	2.1
PE	14.7	1.8
比較例	0.5	5.5

#### 【0030】

【効果】以上詳細に説明したように、この出願の第一の発明による回路基板の接合方法では、回路基板の少なくとも片側面の絶縁材を予め取り除き、この取り除いた部分に被接合物を当接させて加圧し、超音波振動を加えて接合するようにしたから、被接合物に導体が直接当接され絶縁材が邪魔した溶接が不完全となるのが防止される。

【0031】第二の発明の方法では、相手方の被接合物が回路基板である場合に少なくともその片側面の絶縁材を予め取り除いておき、その部分同士を当接させて超音波溶接せねば、同様に導体同士が完全に超音波溶接されるという利点が得られる。

【0032】第三の発明の方法によると、回路基板の絶縁材を予め少なくとも溶接部分について超音波溶接時に除去可能なものとし、これに被接合物を当接させ加圧し、超音波振動を加えて接合するようにしたから、導体部分を絶縁被覆したまま超音波溶接しても完全な溶接結果が得られ、剥離強度のばらつきのない良好な溶接が可能となる。

#### 【図面の簡単な説明】

【図1】回路基板同士を超音波溶接する接合方法の実施

## 例の断面図

【図2】回路基板同士を超音波溶接する接合方法の他の実施例の断面図

【図3】回路基板同士を超音波溶接する接合方法のさらに別の実施例の断面図

【符号の説明】

1 超音波振動子

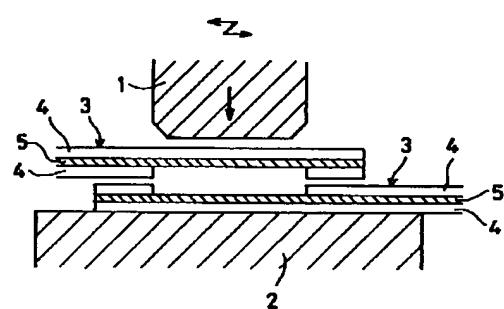
2 アンビル

3、4 絶縁材

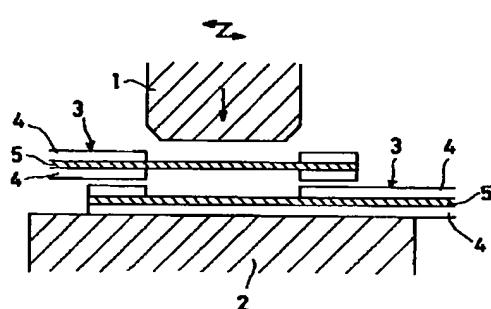
3'、4' 絶縁材

5 導体

【図1】



【図2】



【図3】

